§6. Density Fluctuation Measurements by Homodyne Reflectometer During IBW Injection

Ejiri, A., Kawahata, K., Seki, T., Watari, T., Tanaka, K.

A homodyne system is characterized by its simplicity and high sensitivity. However, it is difficult to analyze the data quantitatively. Most of the difficulty arises from the fact that homodyne systems can not resolve the amplitude and phase fluctuations clearly.

A homodyne system is used to measure qualitative fluctuations, particularly,during IBW injection. Three oscillators (27, 33, 39 GHz) are used as a probing wave, and they are launched as an O-mode. When we divide the fluctuation power into frequency components, higher frequency ($\gtrsim$100kHz) components show a clear (large) change during IBW injection, but lower ones show slight change. Here we mainly describe the behavior of high frequency components.

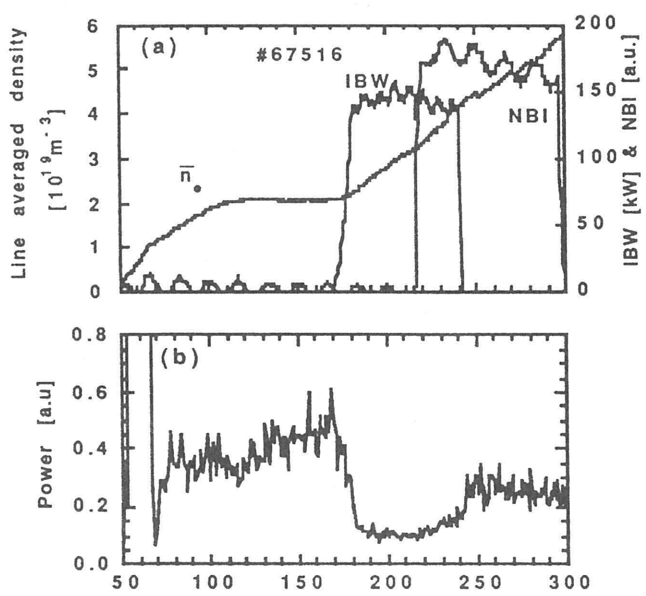

Fig.1. Time evolutions of line averaged density, IBW and NBI heating power (a), and the power (>400kHz) of the reflectometer.

Fig.1 shows the power of high frequency components during IBW and NBI heating for 27GHz measurements. The line averaged electron density is also shown. The reflectometer signal becomes small during the IBW. The time scale of the change is almost the same as that of IBW injection power. Since the fluctuation power changes very fast when the IBW is turned on or off, the effect of the cutoff layer position seems to be negligible. If we assume a parabolic density profile, the cutoff layer position moves from r_C/a~0.8 to ~0.9. Generally, the amplitude of fluctuations of the reflectometer signals is affected by the position of the (O-mode) cutoff layer and by the density fluctuations. Since the IBW tend to increase the density, we must take into account the change in reflection layer position. Its effect can be simulated by gas puffing. When the cutoff layer is located at inner region ($r_C/a \lesssim 0.7$), the signal shows a gradual increase with the density increase. This is probably due to the large curvature of the reflection layer. Further density increase ($r_C/a \gtrsim 0.7$) shows saturation in fluctuation power, except the case when a very strong gas-puffing is done. In addition, gas-puffing can not cause a fast increase or drop as seen in the IBW injection. 33GHz measurements show a fast drop when the initial density is high ($r_C/a \gtrsim 0.6$), and a slow increase when the density is low ($r_C/a \lesssim 0.6$). 39GHz measurements ($r_C/a \lesssim 0.7$) always show a slow increase (Fig.2). This slow increase appears to be caused by the moving reflection layer. As seen in Fig.2, the power shows a fast increase just after turning off of the IBW, when the reflection layer moves to the outer region (r/a~0.8).

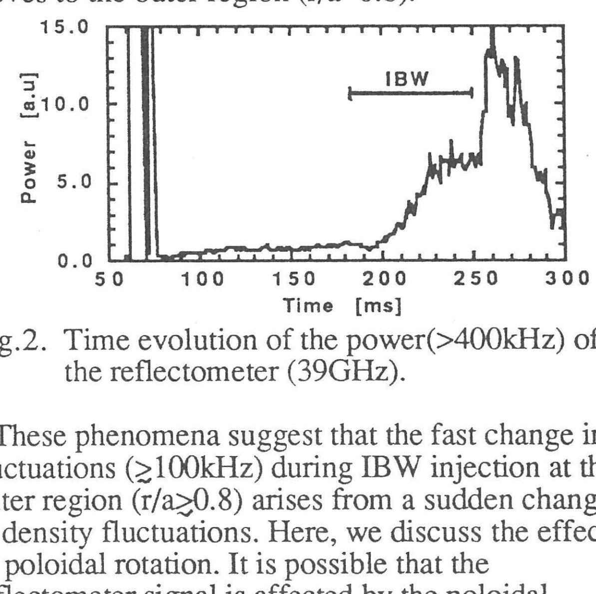

Fig.2. Time evolution of the power(>400kHz) of the reflectometer (39GHz).

These phenomena suggest that the fast change in fluctuations ($\gtrsim$100kHz) during IBW injection at the outer region ($r/a \gtrsim 0.8$) arises from a sudden change in density fluctuations. Here, we discuss the effect of poloidal rotation. It is possible that the reflectometer signal is affected by the poloidal rotation of density perturbations. In this case, the frequency of fluctuations shifts, and the fast change in high frequency components could suggest 100 kHz shift in frequency. However, the potential measured by an HIBP changes with the same time scale as that of electron density. Thus, we conclude that the fast change is probably caused by the suppression of density fluctuations. At the inner region ($r/a \lesssim 0.7$), it is difficult to correct the effect of moving reflection layer by the present homodyne system. However, we often observe a small dip in fluctuation power.